

INDOOR AIR QUALITY ASSESSMENT

**Massachusetts Criminal Justice Training Council
at the
Boylston Town Offices Building
221 Main Street
Boylston, Massachusetts**



Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
August, 2000

Background/Introduction

At the request of a parent, an indoor air quality assessment was done at the Boylston Elementary School at the Boylston Town Offices Building, 221 Main Street, Boylston, Massachusetts. This assessment was conducted by the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA).

On March 14, 2000, Michael Feeney, Chief of Emergency Response/Indoor Air Quality (ER/IAQ), BEHA made a visit to this school, to conduct an indoor air quality assessment. Mr. Feeney was accompanied in part by Dennis Costello, Boylston Board of Health and Charles McCarthy, Principal of the Boylston Elementary School.

The Boylston Town Offices Building is a two-story steel frame structure built in 1973 on the campus of the Sheppard Knapp School. After the private school ceased operation, the building was used as office space by Digital Equipment Corporation (DEC). DEC appears to have modified the second floor rooms and cafeteria area. The Town of Boylston obtained the building after DEC ceased operation in the mid-1990s and was converted to space for town offices.

As part of a current renovation project, students from the Boylston Elementary School were temporarily moved into the first floor and two rooms on the second floor. Once the planned renovations are complete, students will be moved from this building and the space occupied by the school revert back to town office space.

The second floor is the Massachusetts Criminal Justice Training Council (MCJTC), which rents this space from the Town of Boylston and uses the five rooms as offices and a training center for police officers and cadets. Alterations were made to the heating ventilation and air-conditioning (HVAC) system by DEC in the space occupied by the MCJTC that do not exist in other areas in the building. For this reason, the conditions in each area will be described in separate reports. The focus of this report is the MCJTC. The

space currently occupied by the Boylston Elementary School is the subject of a separate report. The section occupied by the school consists of classrooms, a gymnasium and a kitchen/cafeteria. Windows in the school section of the building are openable. The HVAC system is capable of providing both heat and chilled air. A chiller connected to the HVAC system is located at the rear of the building.

The section occupied by the MJCTC consists of three large meeting rooms and two offices. It was reported that the classrooms on the second floor would be reoccupied by the MCJTC once Boylston Elementary School students move from the building. Windows in the MCJTC section of the building are openable. The HVAC system is capable of providing both heated and chilled air. A chiller connected to the HVAC system is located at the rear of the building.

Methods

Air tests for carbon dioxide were taken with the Telaire, Carbon Dioxide Monitor and tests for temperature and relative humidity were taken with the Mannix, TH Pen PTH8708 Thermo-Hygrometer.

Results

The school has a police officer and cadet population of approximately 70 and a staff of approximately 5-7. Tests were taken under normal operating conditions. Test results appear in Table 1.

Discussion

Ventilation

It can be seen from the tables that carbon dioxide levels were elevated above 800 parts per million (ppm) in two of five areas surveyed, which is indicative of a ventilation problem in these areas. Fresh air is supplied by a mechanical unit ventilator (univent) system ([see Figure 1](#)). Univents were not operating during the assessment. Of note was classroom 1BTO201, which had a carbon dioxide level over 2,000 ppm, indicating little air exchange in this room. To function as designed, univents and univent returns must remain free of obstructions. Importantly, these units must be activated and allowed to operate while rooms are occupied.

It appears that additional fan coil units (FCUs) were retrofitted into the heating pipes in the large meeting rooms on the second floor (see Picture 1). These FCUs were not part of the original HVAC system, but were believed installed during the DEC occupancy of the building. Each of these FCUs appears to be equipped to provide both heat and air conditioning. The FCUs do not supply fresh air, but rather only heat or cool recirculated air.

With the exception of restrooms, no mechanical exhaust ventilation system exists in this building. Second floor rooms have a passive non-mechanical exhaust vent located over windows (see Picture 2). In order to function, this ventilation system relies on positive pressure created by the univent to force air out of the passive vent. As the univent operates, air pressure increases as additional fresh air is introduced into the classroom (called positive pressure). As positive pressure increases, air is forced out of the room through wall and door spaces. The passive vent is designed to allow for slow release of air from classrooms by increasing positive pressure created by the univent. The design of these exhaust vents requires that classroom hallway doors remain closed as much as practical in order to maintain positive pressure. With hallway doors open, classroom air would be forced into hallways. In addition, several of these passive vents were examined and were noted to be

backdrafting cold air into classrooms. Previous experience indicates that these types of systems tend to backdraft cold air during winter months. Without a mechanical system, these vents may not function to provide exhaust ventilation and be a source of cold air during winter months. In order to have these vents operate as designed, doors and windows must remain closed in classrooms equipped with these vents.

With the absence of active mechanical exhaust ventilation, pollutants generated during building occupancy will tend to linger in classrooms. Degrading the ability of the HVAC system to create positive pressure in the MCJTC classrooms are the existence of passive vents in the base of hallway doors (see Picture 3). Since air can readily flow through these vents even with classroom hallway doors closed, the HVAC system will have a difficult time building up positive pressure to expel air through the passive exhaust vents above windows.

To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy. In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. The date of the last servicing and balancing was not available at the time of the assessment.

The Massachusetts Building Code requires a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. As carbon dioxide levels rise, it

indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this occurs a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week based on a time weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches.

Temperature readings ranged from 73⁰F to 77⁰F, which was within BEHA's recommended comfort guidelines. The BEHA recommends that indoor air temperatures be maintained in a range of 70⁰F to 78⁰F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

The relative humidity in this building was below the BEHA recommended comfort range in all areas sampled. Relative humidity measurements ranged from 11 to 20 percent. The BEHA recommends that indoor air relative humidity is comfortable in a range of 40 to 60 percent. Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

Of note is the univent design. Instead of installing univents as a complete metal case, it appears that the internal workings of a univent were encased in specially built wooden cabinets (see Picture 4). Within these cabinets are pipes clad with fiberglass insulation (see Picture 5). Since these univents can provide chilled air during warm months, moist air introduced into these wooden cabinets can result in the wetting of the insulation paper. It appears that mold may have colonized the insulation paper (see Picture 6). This colonization may be a source of spores and other mold-related particulates, which can be aerosolized by the univent. Other sources of mold colonization of pipe insulation exist in the gymnasium (see Picture 7). Leaks from the heating system resulted in active mold growth on the exterior of the insulation.

Each univent is equipped with drip pans to collect and drain condensation from cooling coils. The manufacturer of these univents provided a styrofoam liner to protect the drip pans from water damage. These styrofoam liners have never been replaced since the installation of the univents (see Picture 8). The accumulation of debris in these drip pans can serve as growth media for mold.

Other Concerns

Other conditions that can potentially affect indoor air quality were noted during the assessment. Wasp nests were found in the interior of the passive exhaust vents on the first floor. It is possible that wasps are in the passive vents in second floor classrooms as well. It is recommended that they be removed as soon as possible in a manner as to not introduce insects or chemical agents into the school via the ventilation system.

Conclusions/Recommendations

In view of the findings at the time of the visit, the following recommendations are made to further improve indoor air quality:

1. Operate univents while classrooms are occupied.
2. Seal passive vents in hallway doors.
3. Examine the feasibility of providing mechanical exhaust ventilation for high occupancy meeting rooms to remove heat and moisture from these areas.
4. Service the louvers of the exhaust vents. Remove wasp nests from vents if present.
5. Examine the feasibility of replacing drip pans in univents.
6. Replace water damaged pipe insulation.
7. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when relative humidity is low. An increase in filter efficiency in the HVAC system may also be advisable. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
8. Remove wasp's nest from interior of passive first floor vent in a manner as to not introduce insects or chemical agents into the building via the ventilation system.

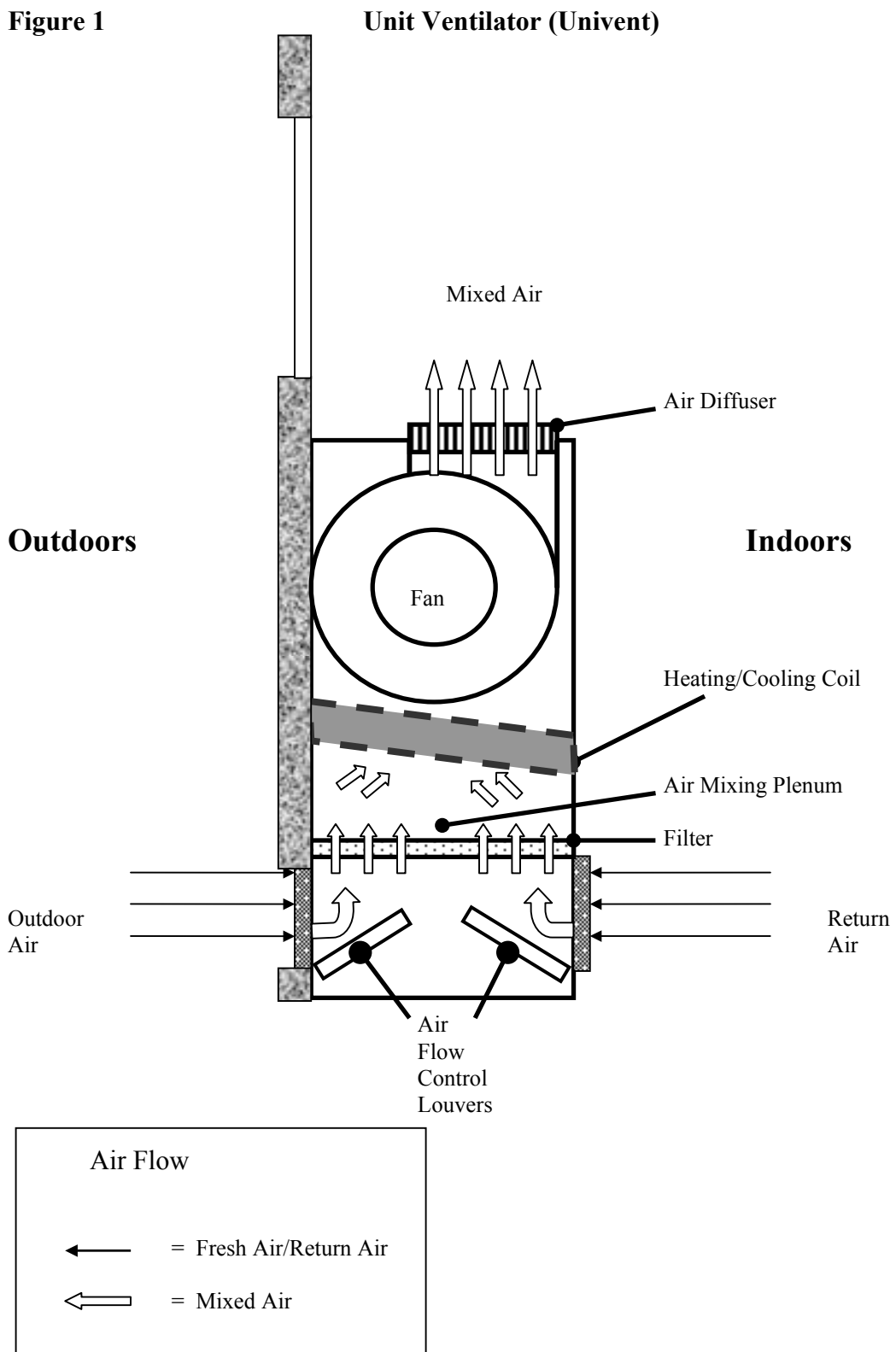
References

BOCA. 1993. The BOCA National Mechanical Code-1993. 8th ed. Building Officials & Code Administrators International, Inc., Country Club Hills, IL. M-308.1

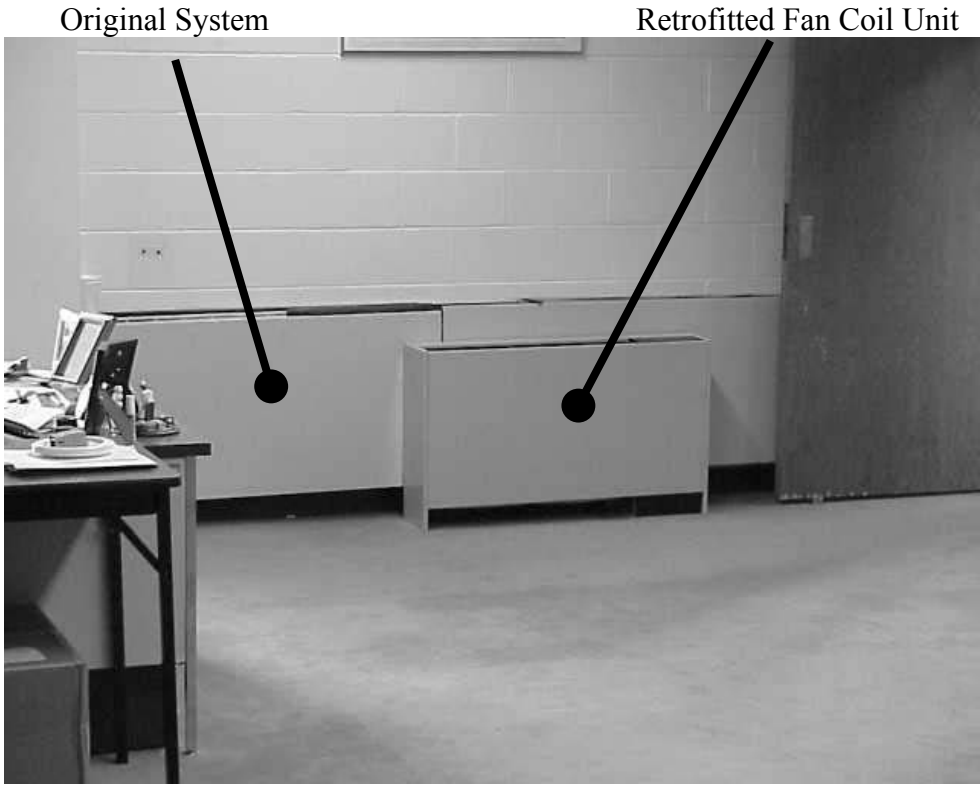
OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R 1910.1000 Table Z-1-A.

SBBRS. 1997. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations. 780 CMR 1209.0

Figure 1

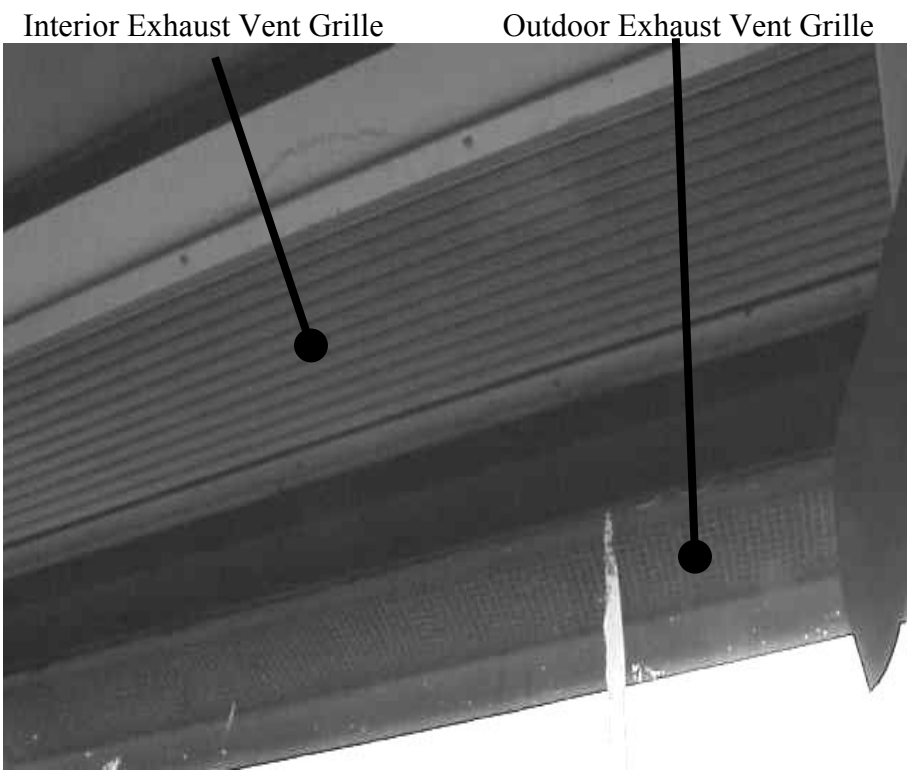


Picture 1



Fan Coil Unit Retrofitted into Original Heating System

Picture 2



Passive Exhaust Ventilation System in Second Floor Rooms

Picture 3



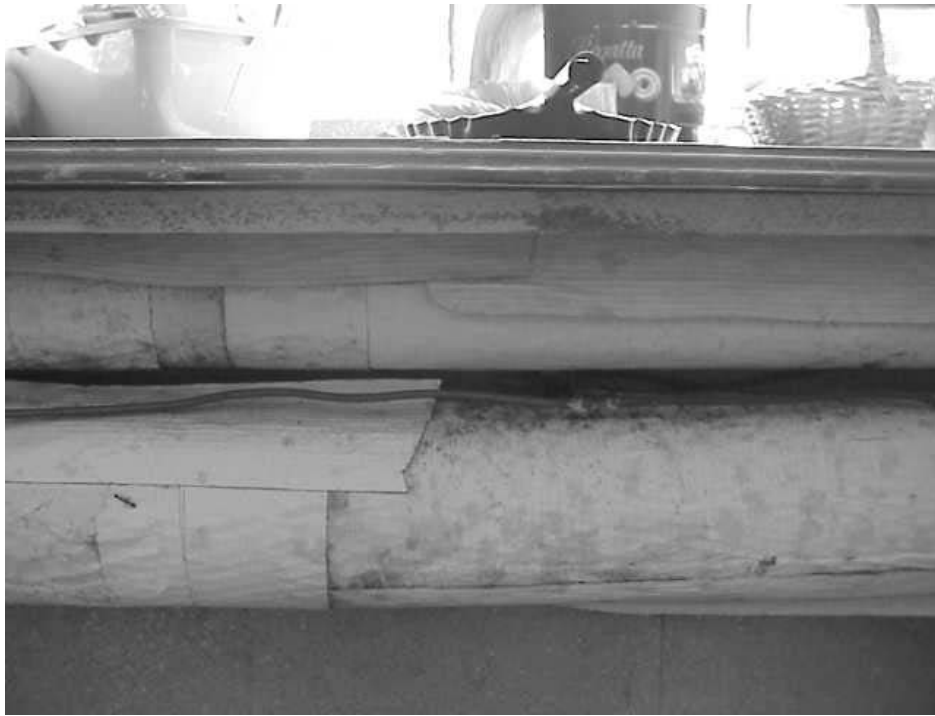
Passive Vent in Hallway Door MCJTC Classroom

Picture 4



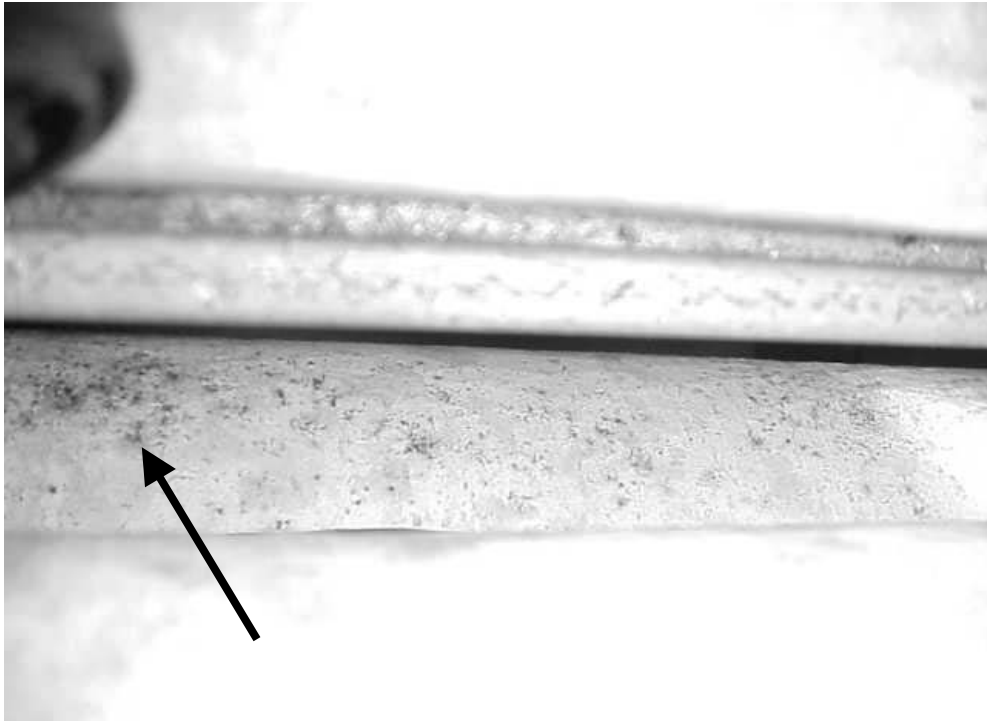
Univent in Wooden Casing

Picture 5



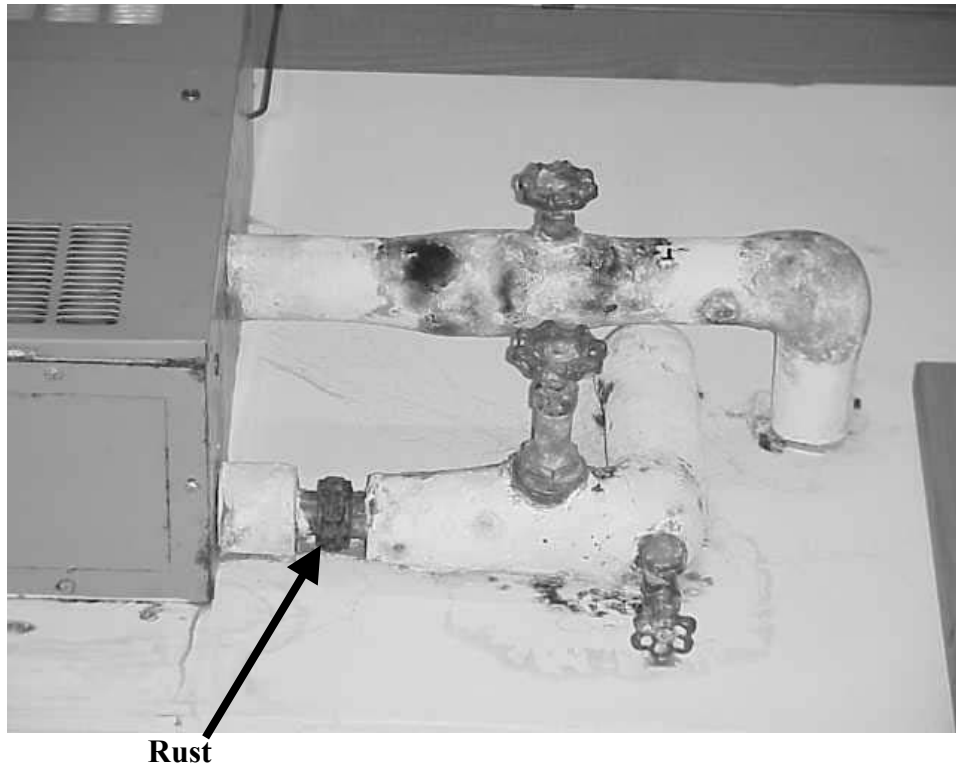
Insulated pipes in Wooden Univent Cabinet, Note Stains/Possible Mold Growth

Picture 6



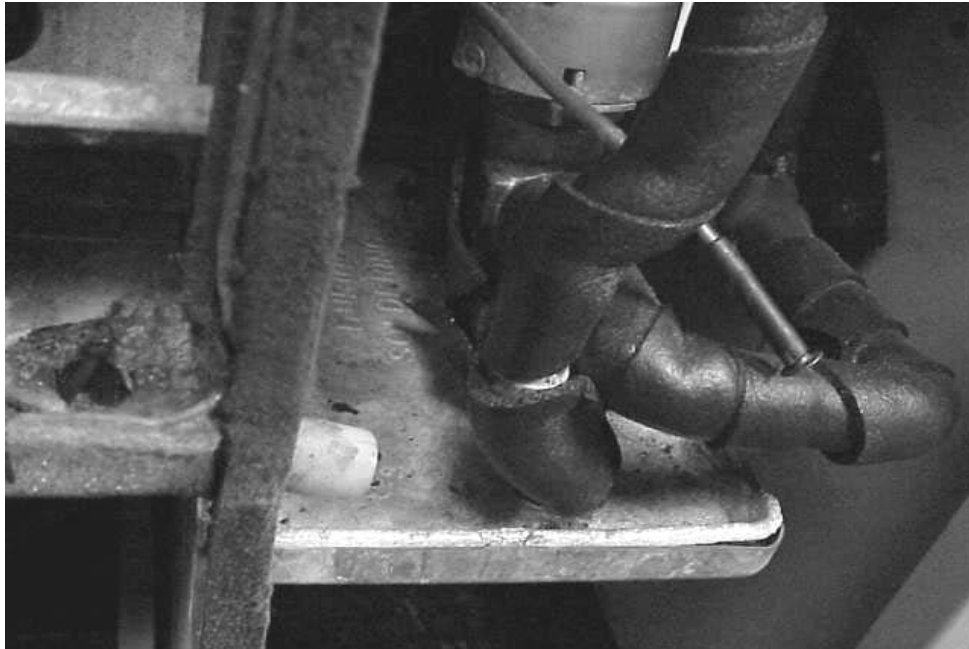
Paper of Pipe Insulation, Note Possible Mold Colonies

Picture 7



Possible Mold Colonization of Insulation, Note Rusted Exposed Pipe That Indicates Possible Condensation Production

Picture 8



Drip Pans in Univent with Accumulated Debris

TABLE 1

**Indoor Air Test Results – Massachusetts Criminal Justice Training Council
at the Boylston Town Offices Building
Boylston, MA
March 14, 2000**

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Outside (Background)	367	43	36					
Academy Director's Office	654	73	12	3	yes	yes	yes	supply off
1BTO207	1625	74	19	19	yes	yes	yes	supply off
1BTO201	2000+	77	20	44	yes	yes	yes	supply off, window open, ceiling fans
Sgt. Rufo's Office	715	73	11	1	yes	yes	yes	photocopier odor

Comfort Guidelines

* ppm = parts per million parts of air
CT = water-damaged ceiling tiles

Carbon Dioxide - < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems
Temperature - 70 - 78 °F
Relative Humidity - 40 - 60%